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Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Mission Operations Status

Denis Elliott

AIRS Science Team Meeting
May 3, 2005

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Outline

- AIRS
- AMSU-A
- Other Aqua instruments
- Aqua spacecraft
- Ground stations

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AIRS Health

- **AIRS is in excellent health**
- **Most engineering parameters show no trend at all**
- **Icing-related parameters, such as cooler active drive level and chopper drive current, are changing slowly and their rate of change is dropping**
  - ***No defrost will be required for the foreseeable future if present trends continue***
- **We have a small number of detectors which have shown increased noise since launch—most likely due to total radiation dosage effects**

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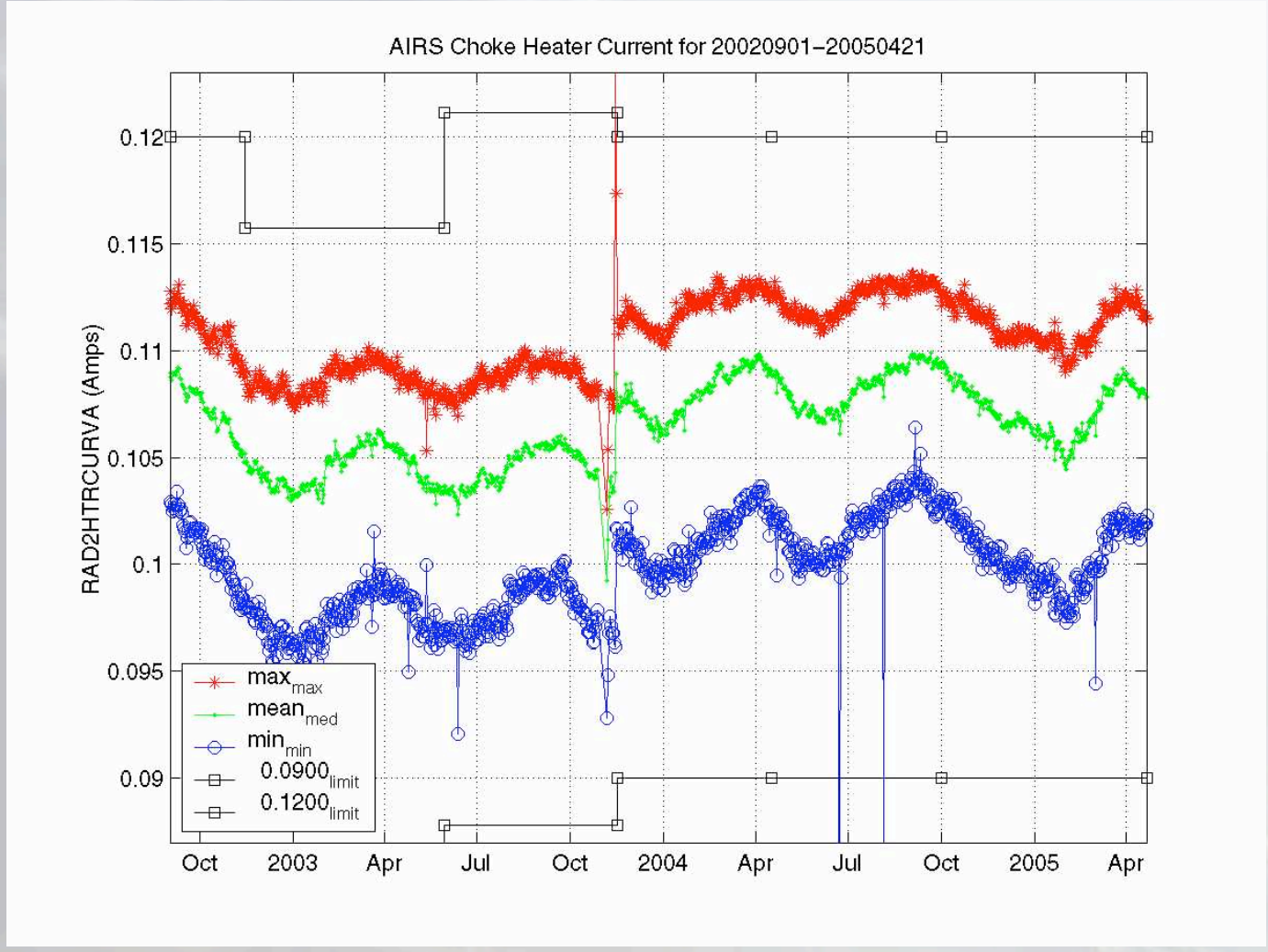
Second-stage Radiator Heater Current



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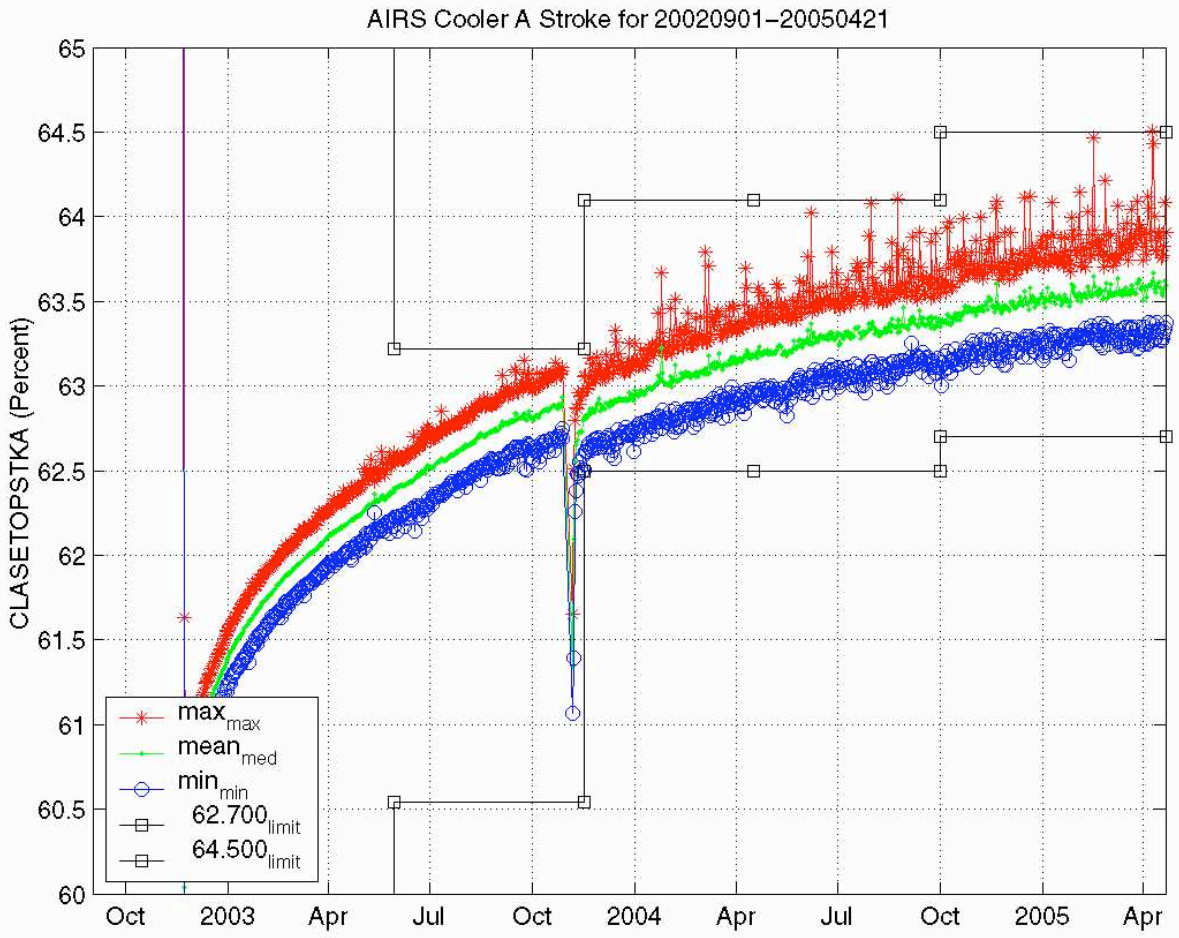
Cooler A Active Drive Level



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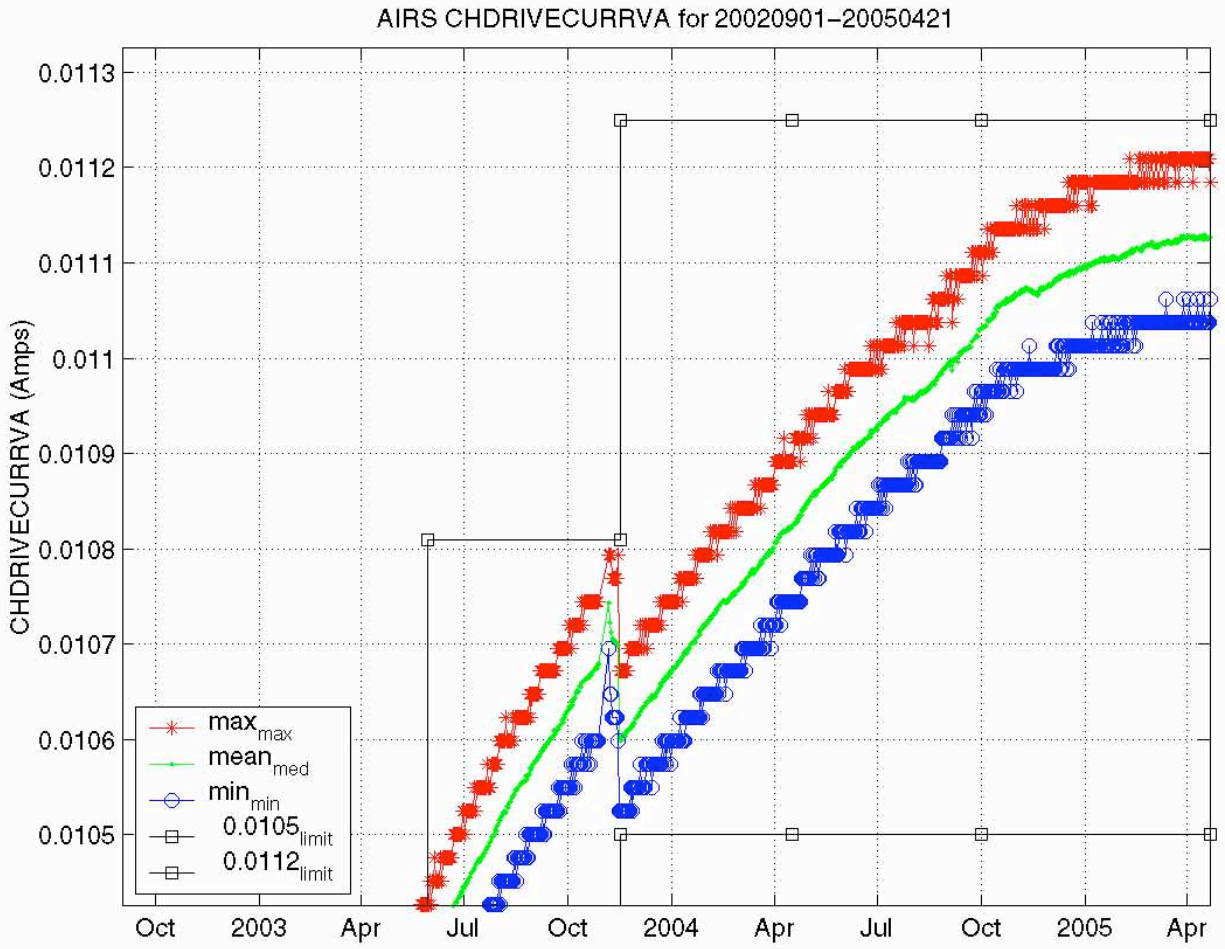
Chopper Drive Current



- **Maximum allowable current is .040 A**

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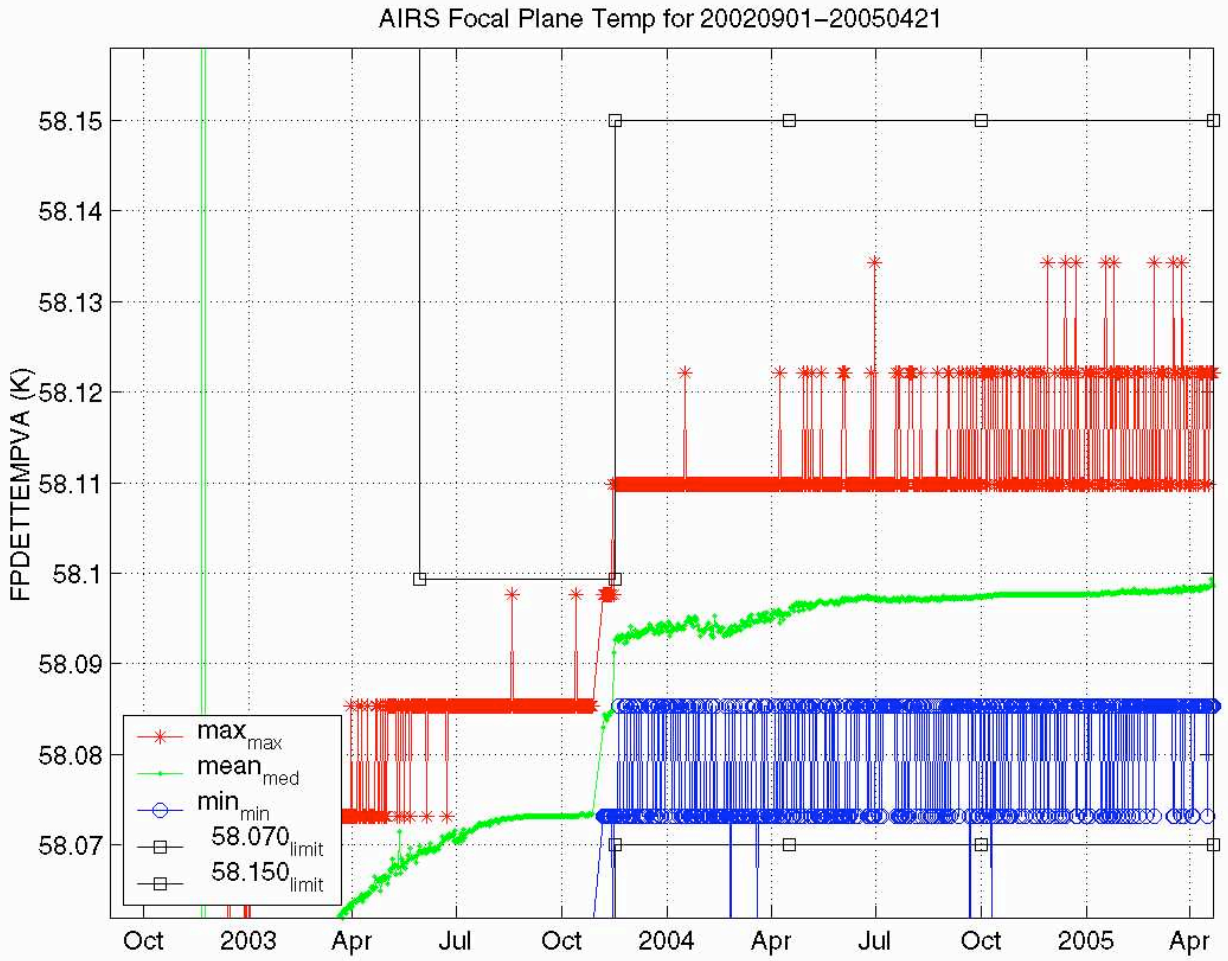
Focal Plane Temperature



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Detector Health

- The vast majority of the 2378 IR channels are behaving the same today as they did at launch
- 19 channels which were normal at launch are now classified as "high noise" by the calibration team
  - *8 channels had their noise increase suddenly, after a passage through the SAA*
  - *1 channel changed during a drag make up burn while the scanner was parked staring at the OBC*
  - *6 channels had their noise increase steadily over a period of a few weeks*
  - *4 channels are cases of cold-scene noise*
- The probable cause is a buildup of total radiation dosage
- Our criterion for "high noise" is that the channel triggers the high noise flag in the PGE on at least 10 granules every day
- Channels on this list may well continue to be useful—the noise criterion is very conservative

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AIRS Anomalies

- There have been only 4 sudden anomalous events on AIRS since launch
- In all these cases the instrument responded as designed and no damage occurred
- The cooler compressor stopped unexpectedly, allowing the focal plane to warm up
  - *August 9, 2002—watch dog timer reset (cooler software bug since patched)*
  - *August 22 and October 19, 2002—false overstroke trips caused by radiation hits in stroke monitoring circuit*
- The scanner unexpectedly parked on November 7, 2004 (caused by SEU in a scan control FPGA register)
- Responsivity in Vis channel 1 (blue) is dropping with time by about 6% per year
  - *Attributed to aging of the scan mirror surface affecting the shortest wavelengths*

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AMSU-A Health

- AMSU-A is in good health
- Many temperatures, voltages, and currents show no long-term trend
- Some are trending up or down, but very slowly
- We are not approaching any yellow limits

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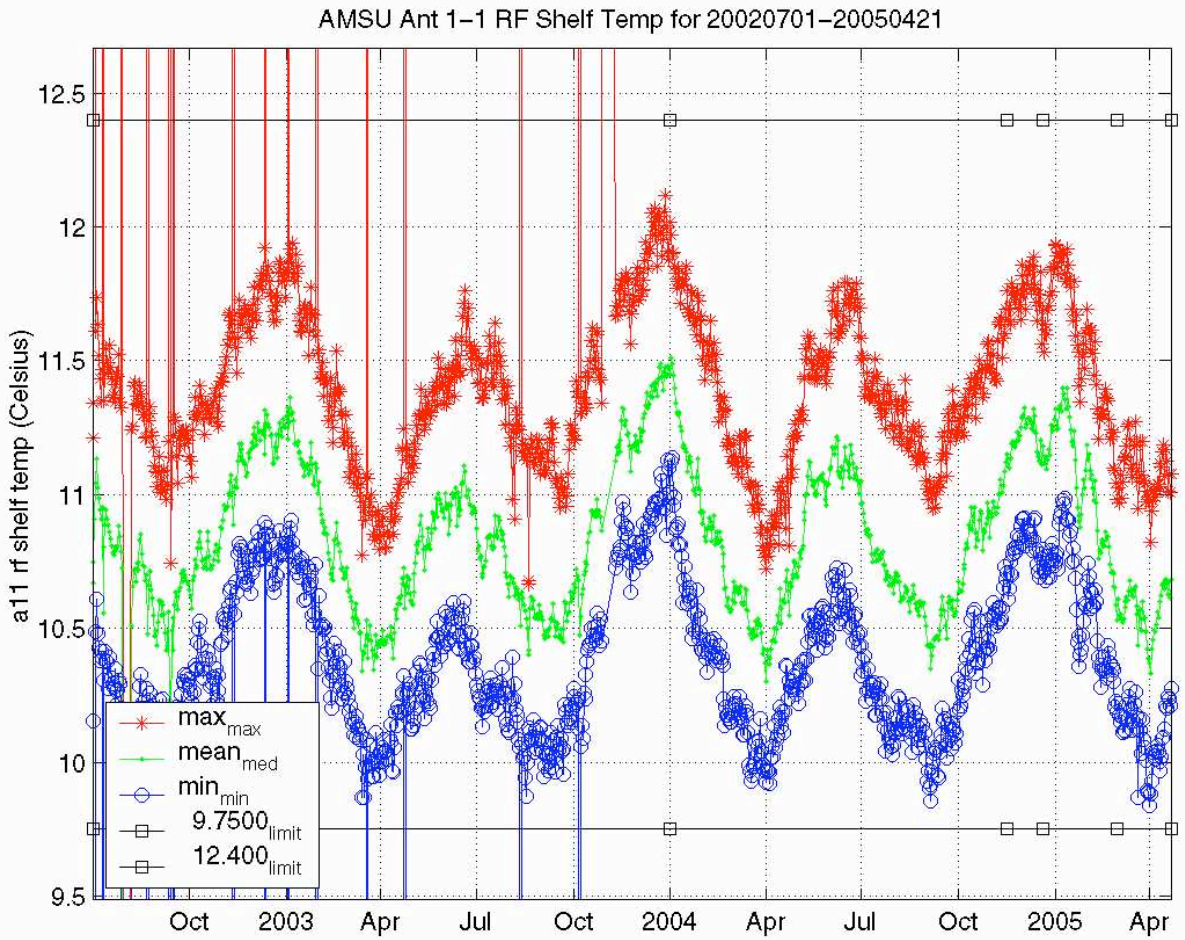
AMSU-A1-1 RF Shelf Temperature



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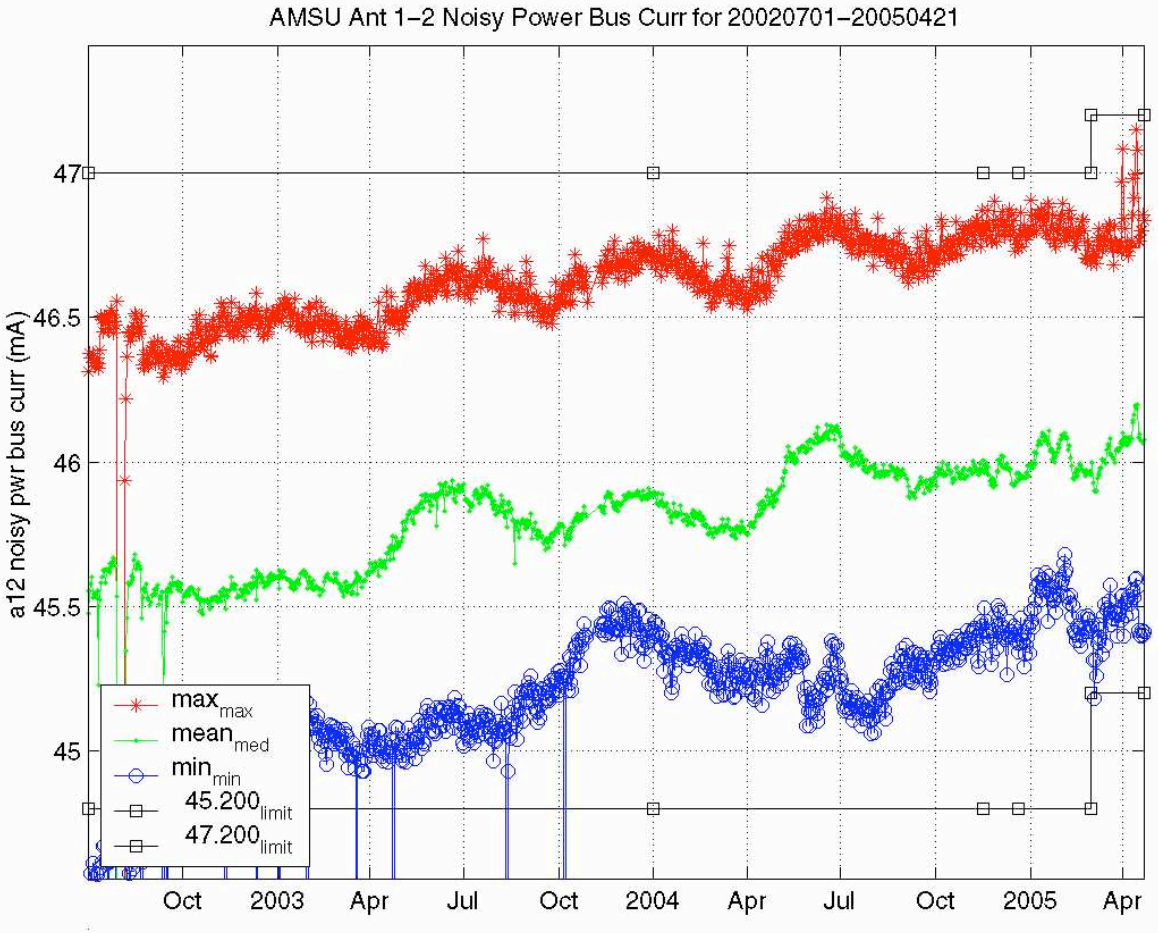
AMSU-A1-2 Noisy Bus Current



- **Yellow limit 100 mA**
- **Red limit 125 mA**

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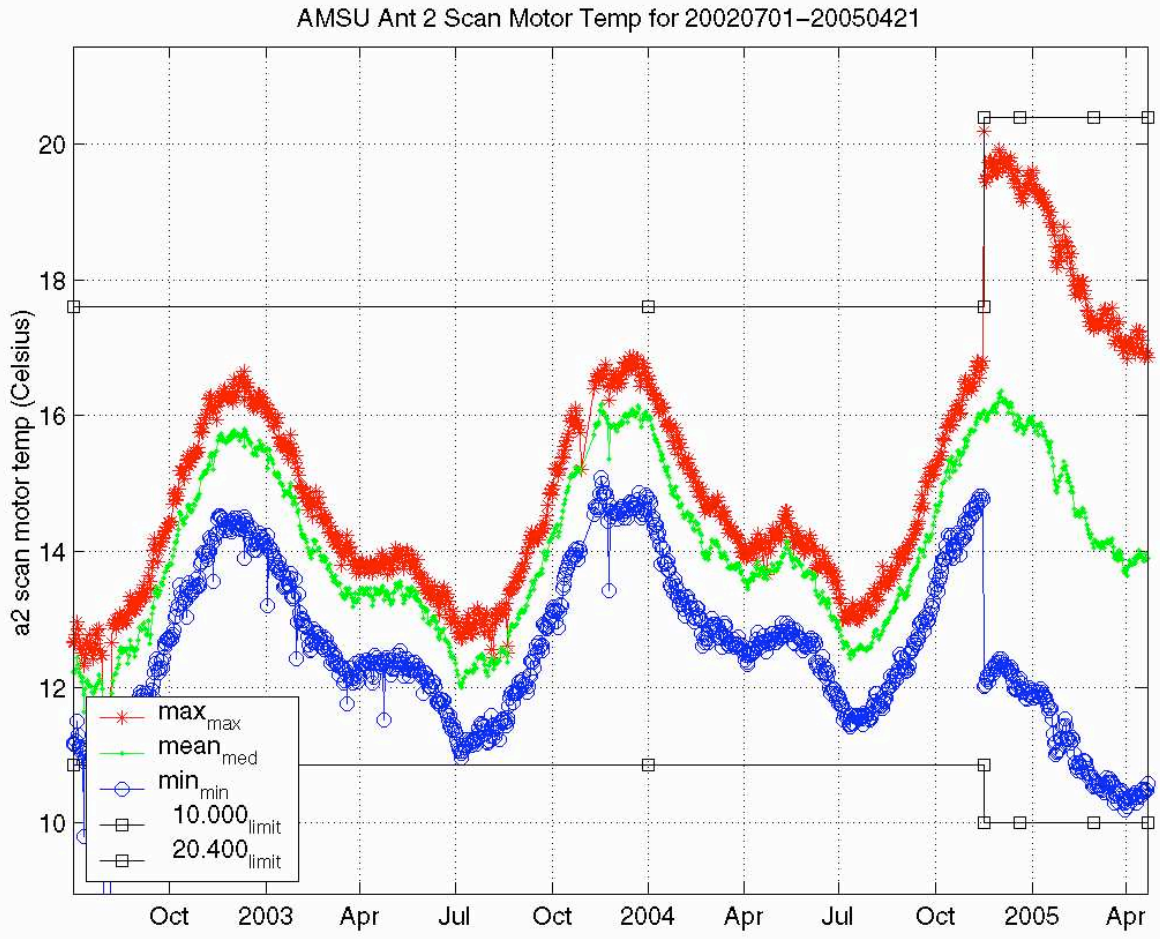
AMSU-A2 Scan Motor Temperature



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AMSU-A2 Temperature Readout Anomaly

- **AMSU-A2 readouts for all temperatures except the warm load suddenly became noisy on November 16, 2004**
  - ***Attributed to loss of a capacitor in the reference voltage circuit—possibilities include:***
    - Bad solder joint or connector or other manufacturing defect
    - Failed capacitor (this particular part has no prior history of failure)
  - ***The warm load temperature readout dropped by 0.15 C at the same time***
  - ***Actual instrument temperatures did not change***
  - ***Smoothing in the PGE can work around the noisy non-warm-load temperatures***
  - ***Only one such temperature is used in the calibration, and it appears in a very small term***
  - ***The offset in the warm load temperature is small and its effect on brightness temperatures is on the order of the noise—the Level 1A software will be updated to correct for it***

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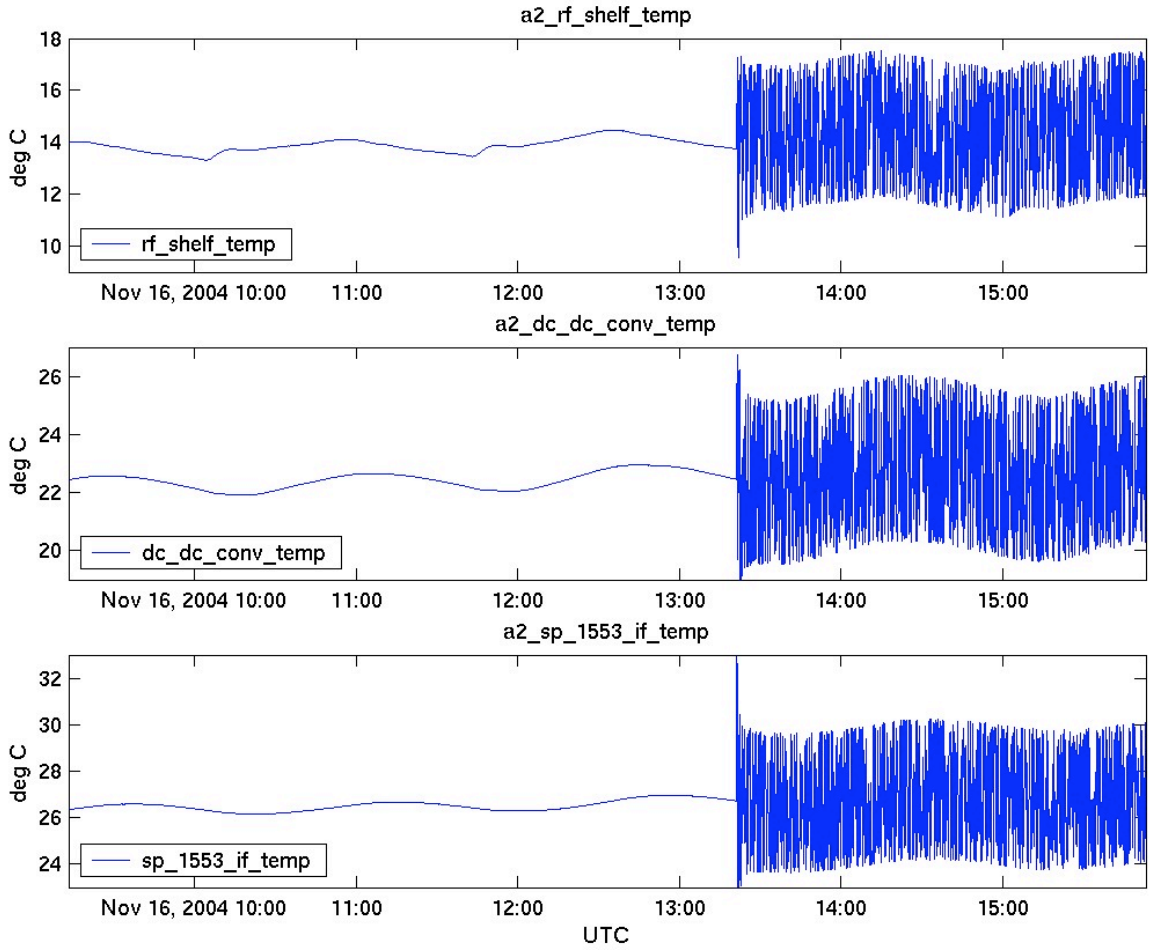
Three AMSU-A2 Temperatures



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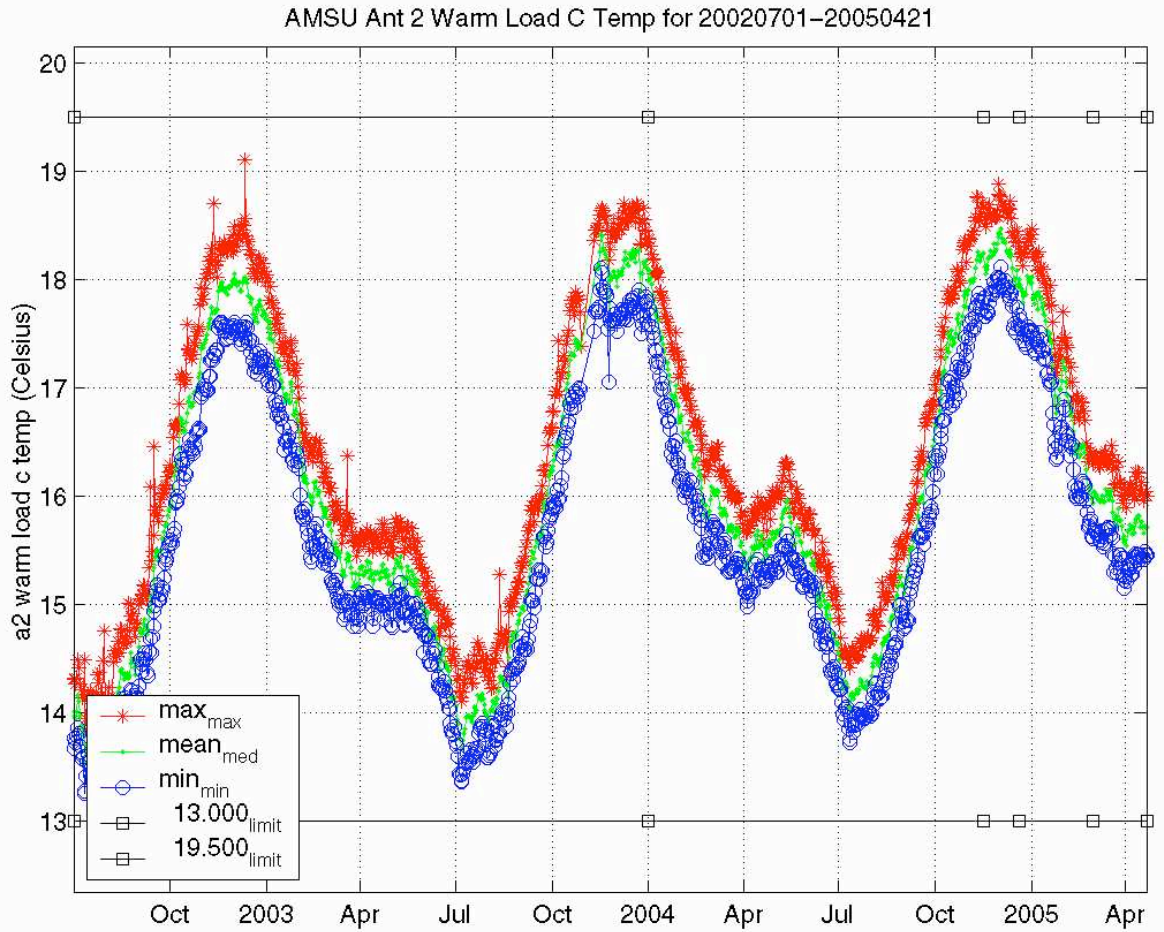
AMSU-A2 Warm Load Temperature



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Other Aqua Instruments

- **MODIS is in good health**
- **AMSR-E is in good health**
- **CERES**
  - ***FM-4 short-wave channel not working as of March 30, 2005***
    - Electronic bridge balance out of range
    - This anomaly is still under investigation by the Aqua FOT and CERES team
  - ***FM-4 mid-wave and long-wave channels are fine***
  - ***FM-3 instrument is in good health***
    - Switched to cross-track mode on March 31

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Aqua Spacecraft Health

- Aqua is in very good health
- All power needs of instruments are being met
- All temperature control needs of instruments are being met
- Primary lifetime-limiting factors are
  - *Propellant for maneuvers*
  - *Battery performance with age*
  - *Solar array performance with age*
- Aqua was designed for a six-year life
- Present trends imply it will easily last six years, and may last twelve years or more
  - *The main uncertainty is the propellant—how much must be reserved for end-of-mission re-entry?*

Open Aqua Spacecraft Anomalies (1 of 2)

- **Solar Array Drive Assembly Potentiometers (SADA Pots)**
  - ***Two redundant pots are used to measure the orientation of the solar array***
    - These measurements are needed during spacecraft initialization and at the start of any spacecraft pointing mode change
    - At all other times, spacecraft software monitors and controls the solar array without need for the Pots
  - ***In December 2002 (primary) and February 2003 (secondary) the Pots began experiencing intermittent high noise over a 20 to 30 degree range of solar array angles***
  - ***Noise typically lasts a day or two, then disappears for weeks***
  - ***Cause unknown***
  - ***Workarounds under consideration involve significant software changes and a new spacecraft pointing mode***
  - ***So far, no maneuver has been compromised***

Open Aqua Spacecraft Anomalies (2 of 2)

- **ARE-4A current and power fluctuations**
  - ***Array Regulator Electronics box 4A power output dropped quickly on September 9, 2004 by 10 to 15 percent***
  - ***Power returned to normal on October 8, but then began a slow, steady decrease in output***
  - ***ARE-4A nominally runs at 8.4% of total solar array power***
  - ***At its lowest point in early October 2004 it was at 7.5%***
  - ***There is considerable power margin on Aqua—other ARE's are easily making up the difference***
  - ***The net result is that total power output has not been compromised, but there is some loss of redundancy***

Ground Stations—Background

- Polar ground stations in Alaska (Alaska Ground Station) and Norway (Svalbard plus two others) are intended to provide almost all communication to/from Aqua
- Limited use of TDRS is allowed, and it is typically used during spacecraft maneuvers
- As backup, an additional Alaska station (Gilmore Creek) can be used part-time
- Wallops Island is also available part-time

Ground Stations—Recent Problems (1 of 2)

- ***Svalbard was declared RED on April 11, 2005***
  - The antenna drive gear failed
- ***A few days later the Alaska Ground Station (AGS) also went RED for a similar reason***
  - Metal shavings were found in the drive gear lubricant
- ***Down time for both will be three to six months***
- ***The Gilmore Creek and Wallops Island stations are now being scheduled as often as possible***
- ***With two stations down, it will be difficult to maintain the near-perfect data capture record we have enjoyed so far***
  - One 20-minute loss has already occurred, early on April 16

Ground Stations—Recent Problems (2 of 2)

- ***WGS cannot send data to EDOS in real time, so data latency will be increased***
  - Whenever WGS is used, there is a minimum of a one-orbit delay in getting the data to EDOS for distribution to NOAA and the EOC
  - Since April 11
    - *2.8% of all Aqua data have been delayed by one orbit*
    - *Due to human error, 0.95% was delayed by one week*

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Summary

- **AIRS is in excellent health**
- **AMSU-A is in very good health**
  - ***One minor anomaly involving temperature readouts on AMSU-A2***
- **The Aqua spacecraft is in very good health**
  - ***Two minor anomalies which do not affect estimated lifetime***
  - ***With present trends, the biggest factor limiting lifetime is propellant supply***
    - EMOS Project at GSFC is trying to obtain permission to reduce its end-of-mission re-entry allocation of propellant
- **Two ground stations are down for three to six months**
  - ***Makes data capture more difficult***
  - ***Increases data latency***

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Backup Slides

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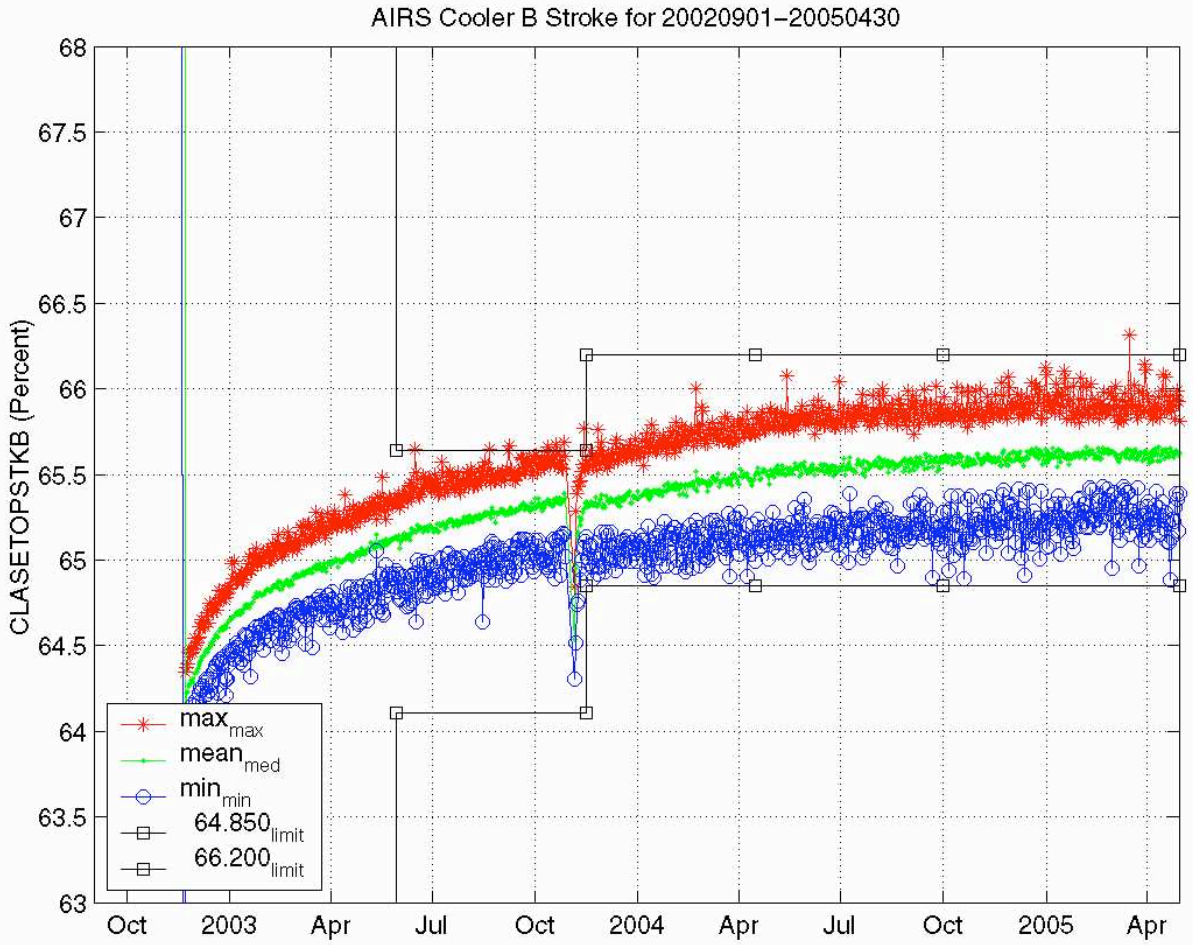
Cooler B Active Drive Level



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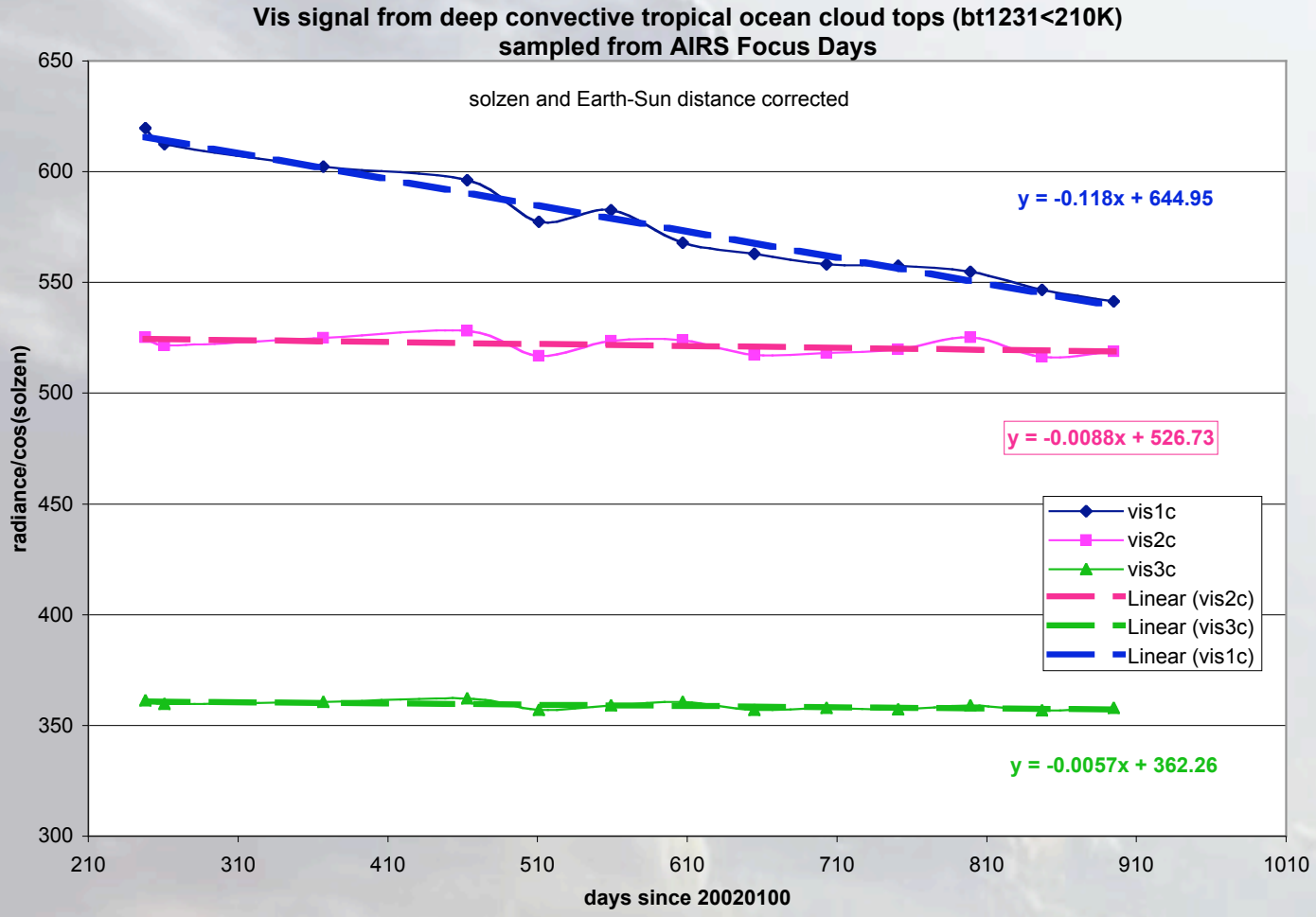
AIRS Vis/NIR Trends



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ARE-4A Power Output

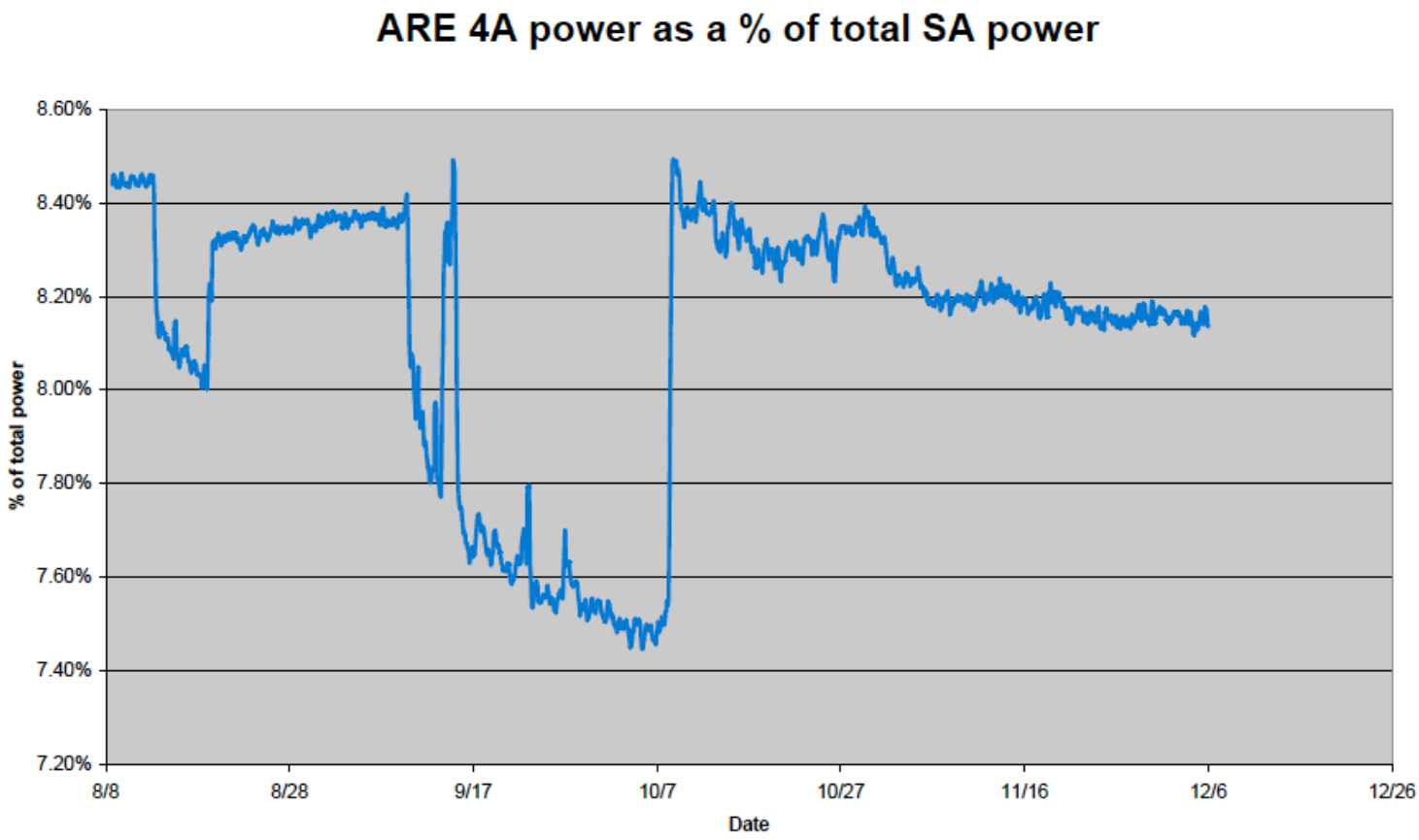

Figure 5: Percent of total SA power produced by ARE 4A